

Cruise Report

U.S. Geological Survey Cruise Report 2017-678-FA

September 17 – September 20, 2017

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USGS

Summary

During September 17 – September 20, 2017, the Pacific Coastal and Marine Science Center of the U.S. Geological Survey (USGS) conducted a survey collecting bathymetry data offshore of the Santa Cruz County shoreline, from Point Santa Cruz to the Moss Landing Harbor jetty. The work was conducted using personal water craft (PWC) out of the Santa Cruz and Moss Landing harbors. This survey is part of a series designed to document changes in shoreline position and coastal morphology in northern Monterey Bay related to episodic, seasonal and interannual processes.

The majority of the California coastline is actively eroding and major storms (El Niño) have caused significant shoreline retreat and property damage. During the next 100 years sea level is projected to rise ~1 m in California (NRC, 2012), making it increasingly important to understand the complex sediment transport and sedimentation patterns that control beach morphodynamics. The West Coast of the United States is among the least understood of the coastal environments, because high wave energy has limited the use of traditional monitoring methods used to study processes controlling sediment transport. The Santa Cruz Littoral Cell has a wide range of coastal morphologic settings, wave exposure, river influences, levels of coastal development and flooding vulnerabilities, making it an excellent opportunity to understand how different sites respond on storm and interannual time scales. This research project has received authorization through the Monterey Bay National Marine Sanctuary under permit **MBNMS-2017-010** and the California Department of Parks and Recreation.

The USGS research 2017-678-FA took place from September 17 – September 20, 2017. All operations took place during daylight hours between 08:04 AM and 1:41 PM Pacific Standard Time (PST). Bathymetric mapping was conducted using a PWC, each equipped with a 200 kHz single beam echosounder and a GPS receiver. In accordance with the MBNMS permit, the vessels launched from either Santa Cruz or Moss Landing harbor and transited directly to the survey sites from Point Santa Cruz (Figure 1) to Moss Landing Harbor (Figure 2) and operated at speeds at, or less than, 4 knots once at the survey site. Fueling occurred prior to launching the vessels and did not land on the shoreline. Prior to operation, the U.S. Coast Guard and two MBNMS points of contact were notified of the plan and purpose for the survey. Figures 1 & 2 show the location of the survey track lines, with track line time and starting and ending locations listed in Table 1. Weather observations are provided in Appendix A and marine wildlife observations are provided in Appendix B. Exhibit H is provided in Appendix C.

References

National Research Council, 2012. Sea-Level Rise for the Coastal of California, Oregon, and Washington: Past, Present, and Future. Washington, DC: The National Academies Press.

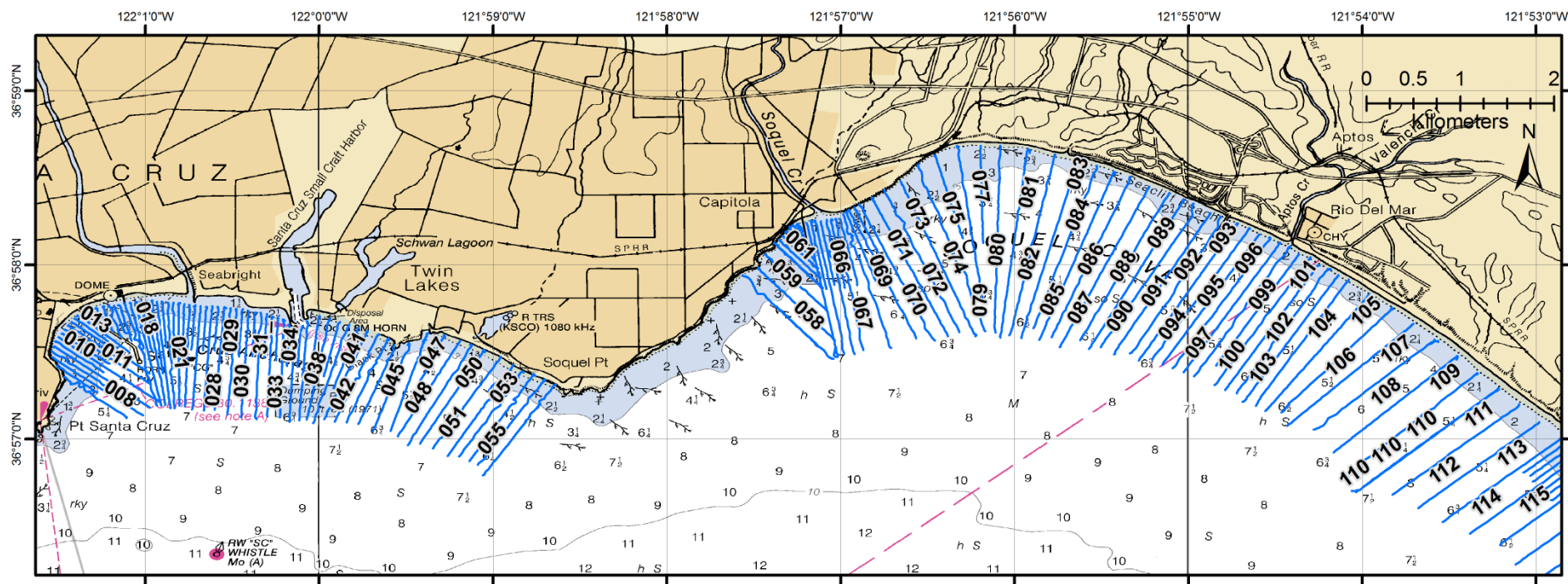


Figure 1. Northern extent of bathymetric data locations collected from September 17 – September 20, 2017 offshore of Santa Cruz County. Map projection is UTM Zone 10, meters.

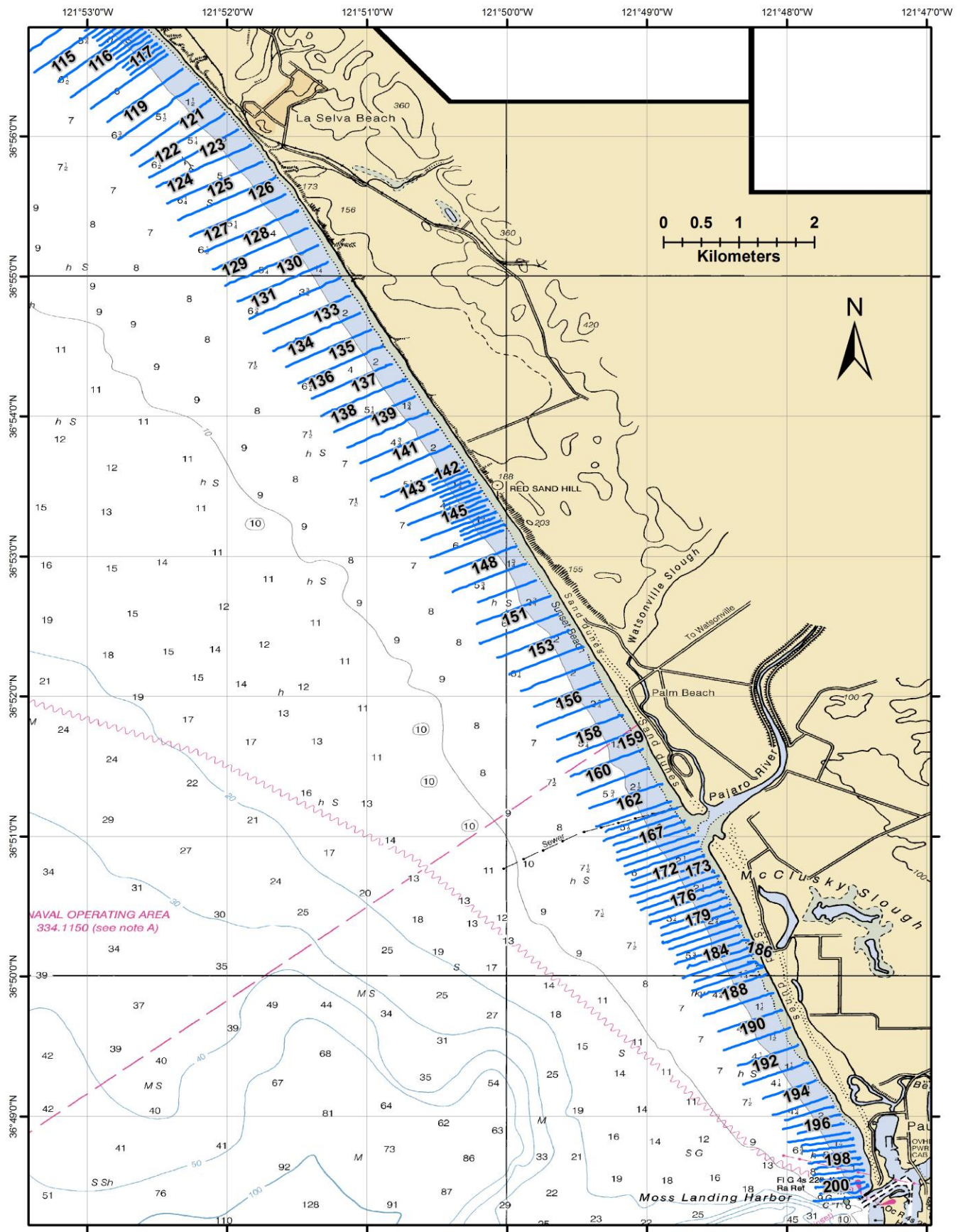


Figure 2. Southern extent of bathymetric data locations collected from September 17 – September 20, 2017 offshore of Santa Cruz County. Map projection is UTM Zone 10, meters.

Table 1. Survey track information.

Line #	Date	Start Time (PST)	Starting Latitude	Starting Longitude	End Time (PST)	Ending Latitude	Ending Longitude
200	9/17/2017	8:04 AM	36.806572	-121.796804	8:07 AM	36.807107	-121.791155
198	9/17/2017	8:08 AM	36.808097	-121.796522	8:12 AM	36.808831	-121.790746
198	9/17/2017	8:15 AM	36.809586	-121.796835	8:18 AM	36.810176	-121.790848
197	9/17/2017	8:20 AM	36.811057	-121.797417	8:23 AM	36.811489	-121.791539
196	9/17/2017	8:26 AM	36.812482	-121.798012	8:29 AM	36.813229	-121.79198
196	9/17/2017	8:31 AM	36.813581	-121.799828	8:35 AM	36.814701	-121.792502
195	9/17/2017	8:43 AM	36.815128	-121.800462	8:47 AM	36.816809	-121.79367
194	9/17/2017	8:54 AM	36.816848	-121.801681	8:58 AM	36.818948	-121.795187
192	9/17/2017	9:00 AM	36.820484	-121.805196	9:04 AM	36.823056	-121.797407
190	9/17/2017	9:07 AM	36.824517	-121.807519	9:11 AM	36.827209	-121.799587
188	9/17/2017	9:15 AM	36.828632	-121.809908	9:20 AM	36.83134	-121.801586
186	9/17/2017	9:24 AM	36.831652	-121.811288	9:30 AM	36.835035	-121.804638
184	9/17/2017	9:32 AM	36.833141	-121.812412	9:37 AM	36.836198	-121.803541
182	9/17/2017	9:39 AM	36.834766	-121.813338	9:44 AM	36.837537	-121.804648
180	9/17/2017	9:46 AM	36.83657	-121.81402	9:50 AM	36.83913	-121.805644
179	9/17/2017	9:53 AM	36.837467	-121.814772	9:59 AM	36.83973	-121.807925
178	9/17/2017	10:01 AM	36.838187	-121.814948	10:06 AM	36.841076	-121.80643
176	9/17/2017	10:08 AM	36.839576	-121.816234	10:13 AM	36.842619	-121.807165
177	9/17/2017	10:26 AM	36.839094	-121.815017	10:31 AM	36.841843	-121.80668
174	9/17/2017	10:33 AM	36.841243	-121.817418	10:39 AM	36.844378	-121.808318
172	9/17/2017	10:41 AM	36.842814	-121.818655	10:46 AM	36.845768	-121.808946
171	9/17/2017	10:48 AM	36.843974	-121.818527	10:54 AM	36.84697	-121.809233
169	9/17/2017	10:56 AM	36.845501	-121.819261	11:00 AM	36.848468	-121.81034
167	9/17/2017	11:03 AM	36.847224	-121.820223	11:08 AM	36.850138	-121.811023
164	9/17/2017	11:20 AM	36.849448	-121.821824	11:25 AM	36.852419	-121.812984
162	9/17/2017	11:27 AM	36.851191	-121.822741	11:31 AM	36.85416	-121.813787
160	9/17/2017	11:36 AM	36.854905	-121.82493	11:40 AM	36.858145	-121.816412
158	9/17/2017	11:43 AM	36.85888	-121.827385	11:48 AM	36.862276	-121.818645
156	9/17/2017	11:50 AM	36.862976	-121.829703	11:55 AM	36.866336	-121.821094
155	9/17/2017	12:06 PM	36.865441	-121.830107	12:10 PM	36.868407	-121.822243
152	9/17/2017	12:13 PM	36.871286	-121.834531	12:18 PM	36.874524	-121.826129
151	9/17/2017	12:21 PM	36.873028	-121.836593	12:26 PM	36.876457	-121.827253
149	9/17/2017	12:35 PM	36.880314	-121.830302	12:35 PM	36.880479	-121.82987
149	9/17/2017	12:35 PM	36.880275	-121.830423	12:39 PM	36.877878	-121.836802
148	9/17/2017	12:40 PM	36.879066	-121.839811	12:44 PM	36.882449	-121.831076
146	9/17/2017	12:47 PM	36.883186	-121.842478	12:52 PM	36.886437	-121.833799
145	9/17/2017	12:54 PM	36.88631	-121.838903	12:56 PM	36.887943	-121.834842
144	9/17/2017	12:57 PM	36.887278	-121.839924	1:00 PM	36.888912	-121.835508
144	9/17/2017	1:01 PM	36.887639	-121.840461	1:04 PM	36.88937	-121.835959
144	9/17/2017	1:07 PM	36.887083	-121.845125	1:12 PM	36.890414	-121.836494
143	9/17/2017	1:13 PM	36.889864	-121.840909	1:15 PM	36.891409	-121.837198
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113	9/18/2017	8:29 AM	36.948993	-121.88034	8:31 AM	36.946482	-121.883883
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105	9/19/2017	9:08 AM	36.962377	-121.897092	9:16 AM	36.952553	-121.907752
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080	9/19/2017	11:02 AM	36.97737	-121.931887	11:12 AM	36.959712	-121.934706
079	9/19/2017	11:09 AM	36.960196	-121.935162	11:19 AM	36.978059	-121.934723
078	9/19/2017	11:18 AM	36.968748	-121.936335	11:23 AM	36.978057	-121.936569
077	9/19/2017	11:20 AM	36.977944	-121.938763	11:29 AM	36.962964	-121.936366
076	9/19/2017	11:25 AM	36.977039	-121.940904	11:30 AM	36.96919	-121.938295
074	9/19/2017	11:32 AM	36.959845	-121.937102	11:40 AM	36.974677	-121.944279
075	9/19/2017	11:33 AM	36.960328	-121.936137	11:43 AM	36.976281	-121.942525
072	9/19/2017	11:42 AM	36.973049	-121.946869	11:50 AM	36.959825	-121.939719
073	9/19/2017	11:43 AM	36.973846	-121.945782	11:52 AM	36.960215	-121.938614
071	9/19/2017	11:53 AM	36.959403	-121.940981	12:01 PM	36.972435	-121.94823
70	9/19/2017	11:54 AM	36.965508	-121.945207	11:58 AM	36.97217	-121.948688
69	9/19/2017	11:59 AM	36.971668	-121.949386	12:03 PM	36.965138	-121.946635
070	9/19/2017	12:02 PM	36.971834	-121.94917	12:09 PM	36.959627	-121.942763
68	9/19/2017	12:05 PM	36.964707	-121.948406	12:09 PM	36.971067	-121.950092
67	9/19/2017	12:10 PM	36.970915	-121.950786	12:14 PM	36.964456	-121.949613
069	9/19/2017	12:10 PM	36.958723	-121.945151	12:18 PM	36.971543	-121.949775
66	9/19/2017	12:16 PM	36.964762	-121.950609	12:19 PM	36.970847	-121.951907
068	9/19/2017	12:19 PM	36.971047	-121.95045	12:26 PM	36.958517	-121.947818
65	9/19/2017	12:20 PM	36.970752	-121.952721	12:24 PM	36.964347	-121.951363
067	9/19/2017	12:27 PM	36.958124	-121.948669	12:33 PM	36.970991	-121.951353
065	9/19/2017	12:32 PM	36.958163	-121.950303	12:35 PM	36.958227	-121.950376
066	9/19/2017	12:34 PM	36.970825	-121.952433	12:42 PM	36.958143	-121.949659
63	9/19/2017	12:35 PM	36.95824	-121.95038	12:35 PM	36.958288	-121.950398
065	9/19/2017	12:36 PM	36.958094	-121.950248	12:43 PM	36.970661	-121.953266
63	9/19/2017	12:44 PM	36.968726	-121.953191	12:47 PM	36.970346	-121.954685
064	9/19/2017	12:46 PM	36.969434	-121.953543	12:47 PM	36.9706	-121.954059
063	9/19/2017	12:48 PM	36.970312	-121.954866	12:50 PM	36.967942	-121.952717
62	9/19/2017	12:48 PM	36.969878	-121.955202	12:51 PM	36.967098	-121.952434
062	9/19/2017	12:50 PM	36.966344	-121.952149	12:53 PM	36.969402	-121.955603
61	9/19/2017	12:51 PM	36.965431	-121.951917	12:55 PM	36.969065	-121.955937
061	9/19/2017	12:54 PM	36.968758	-121.956358	12:55 PM	36.967749	-121.955383
061	9/19/2017	12:57 PM	36.968751	-121.956396	1:00 PM	36.964441	-121.951843
064	9/19/2017	12:57 PM	36.970424	-121.954272	12:58 PM	36.96982	-121.953591
063	9/19/2017	12:59 PM	36.970217	-121.95479	1:01 PM	36.967753	-121.952548

062	9/19/2017	1:00 PM	36.966484	-121.952479	1:03 PM	36.969423	-121.9556
061	9/19/2017	1:03 PM	36.964469	-121.951694	1:07 PM	36.968652	-121.956209
060	9/19/2017	1:05 PM	36.967669	-121.957296	1:10 PM	36.962241	-121.951311
059	9/19/2017	1:08 PM	36.966301	-121.957784	1:14 PM	36.959434	-121.950533
058	9/19/2017	1:12 PM	36.957673	-121.950697	1:18 PM	36.965689	-121.959387
058	9/19/2017	1:16 PM	36.958877	-121.952148	1:19 PM	36.962693	-121.956164
001	9/19/2017	1:35 PM	36.963939	-122.001734	1:39 PM	36.963933	-122.001916
054	9/20/2017	8:50 AM	36.963796	-122.001541	9:12 AM	36.946416	-121.983232
055	9/20/2017	9:05 AM	36.94654	-121.984306	9:13 AM	36.955217	-121.977344
053	9/20/2017	9:14 AM	36.956021	-121.979258	9:20 AM	36.947901	-121.985587
054	9/20/2017	9:15 AM	36.947552	-121.984797	9:21 AM	36.955621	-121.978552
051	9/20/2017	9:21 AM	36.948377	-121.987689	9:28 AM	36.957113	-121.981389
052	9/20/2017	9:22 AM	36.95634	-121.980412	9:28 AM	36.948323	-121.986605
050	9/20/2017	9:29 AM	36.949099	-121.989125	9:35 AM	36.957872	-121.982621
049	9/20/2017	9:29 AM	36.958318	-121.98413	9:35 AM	36.949555	-121.990347
048	9/20/2017	9:37 AM	36.959033	-121.985558	9:43 AM	36.94942	-121.991504
047	9/20/2017	9:39 AM	36.950247	-121.992465	9:45 AM	36.959426	-121.98648
046	9/20/2017	9:44 AM	36.954978	-121.990668	9:47 AM	36.959912	-121.988073
045	9/20/2017	9:46 AM	36.959473	-121.98973	9:47 AM	36.96008	-121.98956
045	9/20/2017	9:47 AM	36.959856	-121.989656	9:53 AM	36.950767	-121.993159
044	9/20/2017	9:49 AM	36.95901	-121.991515	9:54 AM	36.950713	-121.994877
043	9/20/2017	9:54 AM	36.951435	-121.996262	9:59 AM	36.959009	-121.992789
042	9/20/2017	9:55 AM	36.951583	-121.997383	10:00 AM	36.959448	-121.993335
041	9/20/2017	10:00 AM	36.959963	-121.994261	10:06 AM	36.951632	-121.998522
042	9/20/2017	10:00 AM	36.959459	-121.993322	10:00 AM	36.959583	-121.993411
040	9/20/2017	10:02 AM	36.960154	-121.995459	10:07 AM	36.951894	-121.999535
039	9/20/2017	10:08 AM	36.954856	-121.998635	10:11 AM	36.960642	-121.996211
038	9/20/2017	10:09 AM	36.951513	-122.000584	10:14 AM	36.960963	-121.997129
037	9/20/2017	10:12 AM	36.961201	-121.997988	10:16 AM	36.956014	-121.999565
036	9/20/2017	10:15 AM	36.961421	-121.999018	10:21 AM	36.951855	-122.001204
035	9/20/2017	10:16 AM	36.956075	-122.000821	10:20 AM	36.961769	-121.999936
33	9/20/2017	10:20 AM	36.960829	-122.001548	10:23 AM	36.956901	-122.002081
034	9/20/2017	10:21 AM	36.951769	-122.001922	10:26 AM	36.961259	-122.001201
033	9/20/2017	10:25 AM	36.951663	-122.00286	10:30 AM	36.960529	-122.002351
032	9/20/2017	10:27 AM	36.961283	-122.003283	10:33 AM	36.952062	-122.003765
031	9/20/2017	10:31 AM	36.961577	-122.004472	10:38 AM	36.95216	-122.004967
030	9/20/2017	10:34 AM	36.951881	-122.006011	10:40 AM	36.96209	-122.005644
029	9/20/2017	10:38 AM	36.952099	-122.00749	10:44 AM	36.962229	-122.006757
028	9/20/2017	10:40 AM	36.962262	-122.007939	10:47 AM	36.952345	-122.008816
027	9/20/2017	10:45 AM	36.962518	-122.008908	10:51 AM	36.95279	-122.010023
026	9/20/2017	10:47 AM	36.952728	-122.011067	10:53 AM	36.962689	-122.010279
024	9/20/2017	10:54 AM	36.962762	-122.012451	10:59 AM	36.953123	-122.012868
025	9/20/2017	10:55 AM	36.952824	-122.012215	11:00 AM	36.962722	-122.011383
022	9/20/2017	11:00 AM	36.952937	-122.013876	11:06 AM	36.96303	-122.014581
023	9/20/2017	11:01 AM	36.962997	-122.013322	11:01 AM	36.962915	-122.013493
020	9/20/2017	11:07 AM	36.963095	-122.016405	11:13 AM	36.953236	-122.014744
023	9/20/2017	11:08 AM	36.962948	-122.013397	11:13 AM	36.953184	-122.01339
018	9/20/2017	11:13 AM	36.953212	-122.015556	11:19 AM	36.962977	-122.018714
021	9/20/2017	11:14 AM	36.952953	-122.01428	11:19 AM	36.963158	-122.01556
016	9/20/2017	11:20 AM	36.962695	-122.020602	11:21 AM	36.96029	-122.019772
019	9/20/2017	11:20 AM	36.963032	-122.017443	11:26 AM	36.95319	-122.01515
015	9/20/2017	11:23 AM	36.962313	-122.021785	11:24 AM	36.961817	-122.022056
015	9/20/2017	11:24 AM	36.961817	-122.022064	11:24 AM	36.961831	-122.022097
15	9/20/2017	11:25 AM	36.962473	-122.021465	11:27 AM	36.960899	-122.020647
16	9/20/2017	11:28 AM	36.962646	-122.02022	11:30 AM	36.959735	-122.018948
017	9/20/2017	11:28 AM	36.960146	-122.018283	11:30 AM	36.962769	-122.019672
17	9/20/2017	11:31 AM	36.962782	-122.019317	11:33 AM	36.959375	-122.017992
18	9/20/2017	11:33 AM	36.958661	-122.016872	11:35 AM	36.963021	-122.018163
19	9/20/2017	11:35 AM	36.958432	-122.016013	11:38 AM	36.963142	-122.017094
20	9/20/2017	11:36 AM	36.963236	-122.015969	11:40 AM	36.956267	-122.014982
21	9/20/2017	11:38 AM	36.963144	-122.01515	11:41 AM	36.958764	-122.014658
22	9/20/2017	11:41 AM	36.958895	-122.013957	11:44 AM	36.963052	-122.013953
23	9/20/2017	11:41 AM	36.958555	-122.013031	11:44 AM	36.962906	-122.01291
24	9/20/2017	11:44 AM	36.962659	-122.011951	11:47 AM	36.958546	-122.012277
25	9/20/2017	11:44 AM	36.962635	-122.010882	11:47 AM	36.958487	-122.011145
27	9/20/2017	11:48 AM	36.958165	-122.008884	11:50 AM	36.962519	-122.008495
26	9/20/2017	11:48 AM	36.95847	-122.010024	11:50 AM	36.962646	-122.009775

29	9/20/2017	11:51 AM	36.962035	-122.00621	11:53 AM	36.957924	-122.006406
28	9/20/2017	11:51 AM	36.962324	-122.007352	11:54 AM	36.957899	-122.007699
31	9/20/2017	11:54 AM	36.957533	-122.00413	11:56 AM	36.961684	-122.003958
30	9/20/2017	11:54 AM	36.957771	-122.005319	11:57 AM	36.961961	-122.00503
032	9/20/2017	11:57 AM	36.961423	-122.003517	12:03 PM	36.952072	-122.003754
32	9/20/2017	11:58 AM	36.960938	-122.002938	12:00 PM	36.956992	-122.003098
009	9/20/2017	12:09 PM	36.952273	-122.016882	12:14 PM	36.9578	-122.025587
010	9/20/2017	12:15 PM	36.958755	-122.02547	12:21 PM	36.953019	-122.016266
008	9/20/2017	12:18 PM	36.952006	-122.018479	12:23 PM	36.955923	-122.024459
011	9/20/2017	12:22 PM	36.953574	-122.015305	12:28 PM	36.959761	-122.024987
008	9/20/2017	12:24 PM	36.957036	-122.025094	12:27 PM	36.954454	-122.021266
009	9/20/2017	12:28 PM	36.955157	-122.02056	12:31 PM	36.958394	-122.025629
012	9/20/2017	12:28 PM	36.960426	-122.024416	12:33 PM	36.955301	-122.016249
10	9/20/2017	12:32 PM	36.959339	-122.025221	12:35 PM	36.956379	-122.020688
013	9/20/2017	12:34 PM	36.956262	-122.016276	12:38 PM	36.961206	-122.023791
11	9/20/2017	12:36 PM	36.957218	-122.020101	12:38 PM	36.960068	-122.02471
12	9/20/2017	12:39 PM	36.9608	-122.024065	12:42 PM	36.957715	-122.019228
014	9/20/2017	12:39 PM	36.961713	-122.023275	12:43 PM	36.958339	-122.018279
13	9/20/2017	12:43 PM	36.958742	-122.019333	12:46 PM	36.961511	-122.023491

Appendix A: Weather Observation Forms

Marine Environmental Variables Form

Dates: 9/17/2017 – 9/20/2017

Date	Time	Latitude	Longitude	Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Monitors
9/17	8:10 am	36.807524°	-121.795338°	Survey	Overcast	Overcast	None	5+ nm	Light	Calm	1-2 ft	Monitor: D. Hoover, S. Smith, C. Johnson
9/18	8:15 am	36.948216°	-121.896197°	Survey	Overcast	Overcast	None	5+ nm	Light	Calm	1-2 ft	A. Snyder, J. Lovering
9/19	9:10 am	36.954652°	-121.905415°	Survey	Clear	Light	Moderate	5+ nm	Light	Calm	1-2 ft	A. Foxgrover, A. Stevens
9/20	11:31 pm	36.959585°	-122.018336°	Survey	Clear	None	Moderate	5+ nm	Light	Calm	1-2 ft	J. Lovering, A. Stevens

Appendix B: Marine Wildlife Observations

Marine Wildlife Observations Form

Date: 9/17/2017

Monitor: D. Hoover, S. Smith, C. Johnson

Time: 8:10 am	Latitude: 36.807524°	Longitude: -121.795338°
Weather: Overcast	Cloud Cover: Overcast	Glare: None
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 1-2 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Pinnipeds observed near jetty.		

Marine Wildlife Observations Form

Date: 9/18/2017

Monitor: A. Snyder, J. Lovering

Time: 8:15 am	Latitude: 36.948216°	Longitude: -121.896197°
Weather: Overcast	Cloud Cover: Overcast	Glare: None
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 1-2 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Dolphin observed.		
Time: 9:37 am	Latitude: 36.923569°	Longitude: -121.872240°
Weather: Overcast	Cloud Cover: Overcast	Glare: None
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 1-2 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Sea otter observed.		
Time: 10:52 am	Latitude: 36.887085°	Longitude: -121.837662°
Weather: Overcast	Cloud Cover: Overcast	Glare: None
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 1-2 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Sea lions observed.		
Time: 11:42 am	Latitude: 36.844915°	Longitude: -121.817934°
Weather: Overcast	Cloud Cover: Overcast	Glare: None
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 1-2 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Sea otter observed.		
Time: 11:42 am	Latitude: 36.846408°	Longitude: -121.819315°
Weather: Overcast	Cloud Cover: Overcast	Glare: None
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 1-2 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Dolphin observed.		

Marine Wildlife Observations Form

Date: 9/19/2017

Monitor: A. Foxgrover, A. Stevens

Time: 9:10 am	Latitude: 36.954652°	Longitude: -121.905415°
Weather: Clear	Cloud Cover: Light	Glare: Moderate
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 1-2 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Dolphins observed.		
Time: 8:41 am	Latitude: 36.970417°	Longitude: -121.952799°
Weather: Clear	Cloud Cover: Light	Glare: Moderate
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 1-2 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Pinniped observed.		

Marine Wildlife Observations Form

Date: 9/20/2017

Monitor: J. Lovering, A. Stevens

Time: 11:31 am	Latitude: 36.959585°	Longitude: -122.018336°
Weather: Clear	Cloud Cover: None	Glare: Moderate
Visibility: 5+ nm	Wind Speed: Light	Sea State: calm
Swell Height: 2-3 feet	Survey Vessel Activity: Survey	
Marine Wildlife Observations and Interactions:		
Pinnepeds observed near wharf.		

Appendix C: Exhibit H

EXHIBIT H

Mitigation Monitoring Program

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
Air Quality and Greenhouse Gas (GHG) Emissions (MND Section 3.3.3)						
MM AIR-1: Engine Tuning, Engine Certification, and Fuels. The following measures will be required to be implemented by all Permittees under the Offshore Geophysical Permit Program (OGPP), as applicable depending on the county offshore which a survey is being conducted. Pursuant to section 93118.5 of CARB's Airborne Toxic Control Measures, the Tier 2 engine requirement applies only to diesel-fueled vessels.	<u>All Counties:</u> Maintain all construction equipment in proper tune according to manufacturers' specifications; fuel all off-road and portable diesel-powered equipment with California Air Resources Board (CARB)-certified motor vehicle diesel fuel limiting sulfur content to 15 parts per million or less (CARB Diesel).	Daily emissions of criteria pollutants during survey activities are minimized.	Determine engine certification of vessel engines.	OGPP permit holder and contract vessel operator; California State Lands Commission (CSLC) review of Final Monitoring Report.	Prior to, during, and after survey activities. Submit Final Monitoring Report after completion of survey activities.	N/A
	<u>Los Angeles and Orange Counties:</u> Use vessel engines meeting CARB's Tier 2-certified engines or cleaner; the survey shall be operated such that daily NO _x emissions do not exceed 100 pounds based on engine certification emission factors. This can be accomplished with Tier 2 engines if daily fuel use is 585 gallons or less, and with Tier 3 engines if daily fuel use is 935 gallons or less.		Review engine emissions data to assess compliance, determine if changes in tuning or fuel are required.			
	<u>San Luis Obispo County:</u> Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 585 gallons or less; all diesel equipment shall not idle for more than 5 minutes; engine use needed to maintain position in the water is not considered idling; diesel idling within 300 meters (1,000 feet) of sensitive receptors is not permitted; use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Verify that Tier 2 or cleaner engines are being used.			
	<u>Santa Barbara County:</u> Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 790 gallons or less.		Calculate daily NO _x emissions to verify compliance with limitations.			
	<u>Ventura County:</u> Use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Verify that Tier 2 or cleaner engines are being used.			
			Investigate availability of alternative fuels.			
			Investigate availability of alternative fuels.			
			Investigate availability of alternative fuels.			
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EXHIBIT H

Mitigation Monitoring Program

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-1: Marine Mammal and Sea Turtle Presence – Current Information.	All State waters; prior to commencement of survey operations, the geophysical operator shall: (1) contact the National Oceanic and Atmospheric Administration Long Beach office staff and local whale-watching operations and shall acquire information on the current composition and relative abundance of marine wildlife offshore, and (2) convey sightings data to the vessel operator and crew, survey party chief, and onboard Marine Wildlife Monitors (MWMs) prior to departure. This information will aid the MWMs by providing data on the approximate number and types of organisms that may be in the area.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document contact with appropriate sources. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; Inquiry to NOAA and local whale watching operators.	Prior to survey.	2/8/17 JW
MM BIO-2: Marine Wildlife Monitors (MWMs).	Except as provided in section 7(h) of the General Permit, a minimum of two (2) qualified MWMs who are experienced in marine wildlife observations shall be onboard the survey vessel throughout both transit and data collection activities. The specific monitoring, observation, and data collection responsibilities shall be identified in the Marine Wildlife Contingency Plan required as part of all Offshore Geophysical Permit Program permits. Qualifications of proposed MWMs shall be submitted to the National Oceanic and Atmospheric Administration (NOAA) and CSLC at least twenty-one (21) days in advance of the survey for their approval by the agencies. Survey operations shall not commence until the CSLC approves the MWMs.	Competent and professional monitoring or marine mammals and sea turtles; compliance with established monitoring policies.	Document contact with and approval by appropriate agencies. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	2/8/17 JW
MM BIO-3: Safety Zone Monitoring.	Onboard Marine Wildlife Monitors (MWMs) responsible for observations during vessel transit shall be responsible for monitoring during the survey equipment operations. All visual monitoring shall occur from the highest practical vantage point aboard the survey vessel; binoculars shall be used to observe the surrounding area, as appropriate. The MWMs will survey an area (i.e., safety or exclusion zone) based on the equipment used, centered on the sound source (i.e., vessel, towfish), throughout time that the survey equipment is operating. Safety zone radial distances, by equipment type, include:	No adverse effects to marine mammals or sea turtles due to survey activities are observed; compliance with established safety zones.	Compliance with permit requirements (observers); compliance with established safety zones. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	2/8/17 JW

EXHIBIT H

Mitigation Monitoring Program

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials												
	<table><tr><th>Equipment Type</th><th>Safety Zone (radius, m)</th></tr><tr><td>Single Beam Echosounder</td><td>50</td></tr><tr><td>Multibeam Echosounder</td><td>500</td></tr><tr><td>Side-Scan Sonar</td><td>600</td></tr><tr><td>Subbottom Profiler</td><td>100</td></tr><tr><td>Boomer System</td><td>100</td></tr></table> <p>If the geophysical survey equipment is operated at or above a frequency of 200 kilohertz (kHz), safety zone monitoring and enforcement is not required; however, if geophysical survey equipment operated at a frequency at or above 200 kHz is used simultaneously with geophysical survey equipment less than 200 kHz, then the safety zone for the equipment less than 200 kHz must be monitored. The onboard MWMs shall have authority to stop operations if a mammal or turtle is observed within the specified safety zone and may be negatively affected by survey activities. The MWMs shall also have authority to recommend continuation (or cessation) of operations during periods of limited visibility (i.e., fog, rain) based on the observed abundance of marine wildlife. Periodic reevaluation of weather conditions and reassessment of the continuation/cessation recommendation shall be completed by the onboard MWMs. During operations, if an animal's actions are observed to be irregular, the monitor shall have authority to recommend that equipment be shut down until the animal moves further away from the sound source. If irregular behavior is observed, the equipment shall be shut-off and will be restarted and ramped-up to full power, as applicable, or will not be started until the animal(s) is/are outside of the safety zone or have not been observed for 15 minutes.</p> <p>For nearshore survey operations utilizing vessels that lack the personnel capacity to hold two (2) MWMs aboard during survey operations, at least twenty-one (21) days prior to the commencement of survey activities, the Permittee may petition the CSLC to conduct survey operations with one (1) MWM aboard. The CSLC will consider such authorization on a case-by-case basis and</p>	Equipment Type	Safety Zone (radius, m)	Single Beam Echosounder	50	Multibeam Echosounder	500	Side-Scan Sonar	600	Subbottom Profiler	100	Boomer System	100					2/8/17 JW
Equipment Type	Safety Zone (radius, m)																	
Single Beam Echosounder	50																	
Multibeam Echosounder	500																	
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Updated: 04/23/2014

EXHIBIT H

Mitigation Monitoring Program

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	factors the CSLC will consider will include the timing, type, and location of the survey, the size of the vessel, and the availability of alternate vessels for conducting the proposed survey. CSLC authorizations under this subsection will be limited to individual surveys and under any such authorization; the Permittee shall update the MWCP to reflect how survey operations will occur under the authorization.					
MM BIO-4: Limits on Nighttime OGPP Surveys.	All State waters; nighttime survey operations are prohibited under the OGPP, except as provided below. The CSLC will consider the use of single beam echosounders and passive equipment types at night on a case-by-case basis, taking into consideration the equipment specifications, location, timing, and duration of survey activity.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Presurvey request for nighttime operations, including equipment specifications and proposed use schedule. Document equipment use. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Approval required before survey is initiated. Monitoring Report following completion of survey.	N/A
MM BIO-5: Soft Start.	All State waters; the survey operator shall use a "soft start" technique at the beginning of survey activities each day (or following a shut down) to allow any marine mammal that may be in the immediate area to leave before the sound sources reach full energy. Surveys shall not commence at nighttime or when the safety zone cannot be effectively monitored. Operators shall initiate each piece of equipment at the lowest practical sound level, increasing output in such a manner as to increase in steps not exceeding approximately 6 decibels (dB) per 5-minute period. During ramp-up, the Marine Wildlife Monitors (MWMs) shall monitor the safety zone. If marine mammals are sighted within or about to enter the safety zone, a power-down or shut down shall be implemented as though the equipment was operating at full power. Initiation of ramp-up procedures from shut down requires that the MWMs be able to visually observe the full safety zone.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Compliance with permit requirements (observers); compliance with safe start procedures. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Immediately prior to survey.	9/17/17 JW

EXHIBIT H

Mitigation Monitoring Program

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MM BIO-6: Practical Limitations on Equipment Use and Adherence to Equipment Manufacturer's Routine Maintenance Schedule.	<p>All State waters; geophysical operators shall follow, to the maximum extent possible, the guidelines of Zykov (2013) as they pertain to the use of subbottom profilers and side-scan sonar, including:</p> <ul style="list-style-type: none"> Using the highest frequency band possible for the subbottom profiler; Using the shortest possible pulse length; and Lowering the pulse rate (pings per second) as much as feasible. <p>Geophysical operators shall consider the potential applicability of these measures to other equipment types (e.g., boomer). Permit holders will conduct routine inspection and maintenance of acoustic-generating equipment to ensure that low energy geophysical equipment used during permitted survey activities remains in proper working order and within manufacturer's equipment specifications. Verification of the date and occurrence of such equipment inspection and maintenance shall be provided in the required presurvey notification to CSLC.</p>	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	<p>Document initial and during survey equipment settings.</p> <p>Submit Final Monitoring Report after completion of survey activities.</p>	OGPP permit holder.	Immediately prior to and during survey.	<p>9/17/17</p> <p>gw</p>
MM BIO-7: Avoidance of Pinniped Haul-Out Sites.	<p>The Marine Wildlife Contingency Plan (MWCP) developed and implemented for each survey shall include identification of haul-out sites within or immediately adjacent to the proposed survey area. For surveys within 300 meters (m) of a haul-out site, the MWCP shall further require that:</p> <ul style="list-style-type: none"> The survey vessel shall not approach within 91 m of a haul-out site, consistent with National Marine Fisheries Service (NMFS) guidelines; Survey activity close to haul-out sites shall be conducted in an expedited manner to minimize the potential for disturbance of pinnipeds on land; and Marine Wildlife Monitors shall monitor pinniped activity onshore as the vessel approaches, observing and reporting on the number of pinnipeds potentially disturbed (e.g., via head lifting, flushing into the water). The purpose of such reporting is to provide CSLC and California Department of Fish and Wildlife (CDFW) with information regarding potential disturbance associated with OGPP surveys. 	No adverse effects to pinnipeds at haul outs are observed.	<p>Document pinniped reactions to vessel presence and equipment use.</p> <p>Submit Final Monitoring Report after completion of survey activities.</p>	OGPP permit holder.	Monitoring Report following completion of survey.	<p>9/30/17</p> <p>gw</p>

EXHIBIT H

Mitigation Monitoring Program

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MM BIO-8: Reporting Requirements – Collision.	<p>All State waters; if a collision with marine mammal or reptile occurs, the vessel operator shall document the conditions under which the accident occurred, including the following:</p> <ul style="list-style-type: none"> • Vessel location (latitude, longitude) when the collision occurred; • Date and time of collision; • Speed and heading of the vessel at the time of collision; • Observation conditions (e.g., wind speed and direction, swell height, visibility in miles or kilometers, and presence of rain or fog) at the time of collision; • Species of marine wildlife contacted (if known); • Whether an observer was monitoring marine wildlife at the time of collision; and, • Name of vessel, vessel owner/operator, and captain officer in charge of the vessel at time of collision. <p>After a collision, the vessel shall stop, if safe to do so; however, the vessel is not obligated to stand by and may proceed after confirming that it will not further damage the animal by doing so. The vessel will then immediately communicate by radio or telephone all details to the vessel's base of operations, and shall immediately report the incident. Consistent with Marine Mammal Protection Act requirements, the vessel's base of operations or, if an onboard telephone is available, the vessel captain him/herself, will then immediately call the National Oceanic and Atmospheric Administration (NOAA) Stranding Coordinator to report the collision and follow any subsequent instructions. From the report, the Stranding Coordinator will coordinate subsequent action, including enlisting the aid of marine mammal rescue organizations, if appropriate. From the vessel's base of operations, a telephone call will be placed to the Stranding Coordinator, NOAA National Marine Fisheries Service (NMFS), Southwest Region, Long Beach, to obtain instructions. Although NOAA has primary responsibility for marine mammals in both State and Federal waters, the California Department of Fish and Wildlife (CDFW) will also be advised that an incident has occurred in State waters affecting a protected species.</p>	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Monitoring Report following completion of survey.	<p>9/30/17</p> <p><i>[Signature]</i></p>

Updated: 04/23/2014

EXHIBIT H

Mitigation Monitoring Program

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-9: Limitations on Survey Operations in Select Marine Protected Areas (MPAs).	All MPAs; prior to commencing survey activities, geophysical operators shall coordinate with the CLSC, California Department of Fish and Wildlife (CDFW), and any other appropriate permitting agency regarding proposed operations within MPAs. The scope and purpose of each survey proposed within a MPA shall be defined by the permit holder, and the applicability of the survey to the allowable MPA activities shall be delineated by the permit holder. If deemed necessary by CDFW, geophysical operators will pursue a scientific collecting permit, or other appropriate authorization, to secure approval to work within a MPA, and shall provide a copy of such authorization to the CSLC as part of the required presurvey notification to CSLC. CSLC, CDFW, and/or other permitting agencies may impose further restrictions on survey activities as conditions of approval.	No adverse effects to MPA resources due to survey activities are observed.	Monitor reactions of wildlife to survey operations; report on shutdown conditions and survey restart. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; survey permitted by CDFW.	Prior to survey.	2/8/17 JW
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Permittees shall develop and submit to CSLC staff for review and approval an OSCP that addresses accidental releases of petroleum and/or non-petroleum products during survey operations. Permittees' OSCP's shall include the following information for each vessel to be involved with the survey: <ul style="list-style-type: none"> Specific steps to be taken in the event of a spill, including notification names, phone numbers, and locations of: (1) nearby emergency medical facilities, and (2) wildlife rescue/response organizations (e.g., Oiled Wildlife Care Network); Description of crew training and equipment testing procedures; and Description, quantities, and location of spill response equipment onboard the vessel. 	Reduction in the potential for an accidental spill. Proper and timely response and notification of responsible parties in the event of a spill.	Documentation of proper spill training. Notification of responsible parties in the event of a spill.	OGPP permit holder and contract vessel operator.	Prior to survey.	2/8/17 JW
MM HAZ-2: Vessel fueling restrictions.	Vessel fueling shall only occur at an approved docking facility. No cross vessel fueling shall be allowed.	Reduction in the potential for an accidental spill.	Documentation of fueling activities.	Contract vessel operator.	Following survey.	9/20/17 JW
MM HAZ-3: OSCP equipment and supplies.	Onboard spill response equipment and supplies shall be sufficient to contain and recover the worst-case scenario spill of petroleum products as outlined in the OSCP.	Proper and timely response in the event of a spill.	Notification to CSLC of onboard spill response equipment/supplies inventory, verify	Contract vessel operator.	Prior to survey.	2/8/17 JW

Updated: 04/23/2014

EXHIBIT H

Mitigation Monitoring Program

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
			ability to respond to worst-case spill.			
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Outlined under Hazards and Hazardous Materials (above)					
MM HAZ-2: Vessel fueling restrictions.	Outlined under Hazards and Hazardous Materials (above)					
MM HAZ-3: OSCP equipment and supplies.	Outlined under Hazards and Hazardous Materials (above)					
MM BIO-9: Limitations on Survey Operations in Select MPAs.	Outlined under Biological Resources (above)					
MM REC-1: U.S. Coast Guard (USCG), Harbormaster, and Dive Shop Operator Notification.	All California waters where recreational diving may occur; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to divers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall: (1) post such notices in the harbormasters' offices of regional harbors; and (2) notify operators of dive shops in coastal locations adjacent to the proposed offshore survey operations.	No adverse effects to recreational divers from survey operations.	Notify the USCG, local harbormasters, and local dive shops of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	2/8/17 JW

Updated: 04/23/2014

EXHIBIT H

Mitigation Monitoring Program

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MM FISH-1: U.S. Coast Guard (USCG) and Harbormaster Notification.	All California waters; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to mariners and fishers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall post such notices in the harbormasters' offices of regional harbors.	No adverse effects to commercial fishing gear in place.	Notify the USCG and local harbormasters of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	2/8/17 gw
MM FISH-2: Minimize Interaction with Fishing Gear.	To minimize interaction with fishing gear that may be present within a survey area: (1) the geophysical vessel (or designated vessel) shall traverse the proposed survey corridor prior to commencing survey operations to note and record the presence, type, and location of deployed fishing gear (i.e., buoys); (2) no survey lines within 30 m (100 feet) of observed fishing gear shall be conducted. The survey crew shall not remove or relocate any fishing gear; removal or relocation shall only be accomplished by the owner of the gear upon notification by the survey operator of the potential conflict.	No adverse effects to commercial fishing gear in place.	Visually observe the survey area for commercial fishing gear. Notify the gear owner and request relocation of gear outside survey area. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Immediately prior to survey (prior to each survey day).	9/17/17 gw
MM FISH-1: USCG and Harbormaster Notification.	Outlined under Commercial and Recreational Fisheries (above)					

Acronyms/Abbreviations: CARB = California Air Resources Board; CDFW = California Department of Fish and Wildlife; CSLC = California State Lands Commission; dB = decibels; kHz = kilohertz; MPA = Marine Protected Area; MWCP = Marine Wildlife Contingency Plan; MWM = Marine Wildlife Monitor; m= meter(s); NOAA = National Oceanic and Atmospheric Administration; NO_x = Nitrogen Oxide; OGPP = Offshore Geophysical Permit Program; OSCP = Oil Spill Contingency Plan; USCG = U.S. Coast Guard